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Innovation Policy Framework for Sustainable Development in Regional Economies: An Australian Perspective

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Abstract

The paper develops a broad macroeconomic innovation policy framework for ecologically sustainable economic development that can be applied to regional economies, from the perspective of Australia. Australia is one of the three huge per capita greenhouse emitting nations in the world. The increased frequency of drought and dramatic storms, together with mounting international scientific evidence, has raised the spectre of greenhouse gas emissions significantly deteriorating the economic viability of regional communities. Up until now from a regional perspective, ecological concerns of pollution and resource depletion have generally been part of the overall management approach to agriculture and regional economic development – more successful in some places and some time periods than others, but still part of the existing economic paradigm.

Greenhouse is "the inconvenient truth" that now faces all regional communities, but its existing economic paradigm is clearly inappropriate for responding effectively and timely to this ecological concern. A completely different economic framework, based on economic activity that is *satisficing* (under conditions of ecological uncertainty) rather than *optimising* (under conditions of calculable risk) is required to address the ecological concerns of the future.

An "eco-sustainable framework" is developed in this paper which sets out an innovation policy aimed at *satisficing* towards sustainable regional development from an Australian high-emission economy perspective. The framework is based on the work of two economists, Michał Kalecki and Adolph Lowe. Kalecki argues for social control of investment, while Lowe argues for "instrumental analysis" to public policy, linking human agency (imagination) to investment behaviour for the purpose of setting long-term goals. Democratic goals need to be specified in terms of ecologically sustainable rules in the context of long-term carrying capacities of the regional ecosystem. The processes to achieve these goals are through investment in innovation networks at the regional community level.

This "eco-sustainable framework" is an attempt to set a policy framework for regional economic development based on consistent and workable public policy tools that encourage and support entrepreneurial innovation that is greenhouse ecologically supportive. The paper concludes by outlining practical applications in regional communities of this framework using concrete examples of ecological-based strategies and their integration into a complete innovation policy that directly addresses climate change.

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The TINA Challenge

Regional economies face serious challenges with the scientific evidence clearly identifying greenhouse warming (or CO_2 emissions) as the cause of significant climate change over the next fifty years. For example, the Garnaut Interim Report (Garnaut, 2008) states that Australia is likely to be more exposed to the impacts of climate change than other developed economies due to four factors: (i) dry and variable continent, (ii) major agricultural base, (iii) terms of trade sensitive to Asian climate change impacts, (iv) fragility of nearby highly exposed developing economies. The first two factors point directly to the agricultural and regional economic core of Regional Australia and its ability to adapt in meeting the climate change challenge. Thus the focus of this paper is on a framework for agricultural and regional economic development that directly addresses most effectively this challenge. This challenge is particularly crucial in Australia because, along with USA and Canada, current CO_2 emissions are four times the global per capita average (Garnaut, 2008, p. 31).

As an eminent Australian economist, Garnaut recognises the need for "…investment in the transition to a low-emission economy," (Garnaut, 2008, p. 39). He goes on to argue that this transition can only occur through technological innovation, and that:

> Policy clarity, continuity and coherence are critical to the formulation of expectations about the future markets that are crucial to encouraging desirable levels of investment in innovation. (Garnaut, 2008, p. 54)

How to bring about this transition quickly and effectively is the major policy issue. In his report Garnaut regularly mentions market failures as significant constraints on generating the market signals for effective transition.[1] The major obstacle to achieving this objective in regional economies is the current market optimality approach to overall agriculture and regional economic development. It is the same economic approach that has been used (and failed) to address environmental issues like river salination, acid rain, water shortage, and lack of establishment of non-fossil fuel energy.

Mainstream traditional environmental economics and more recent ecological economics have the same optimality approach. This approach is the dominant paradigm and represents what the French call "la pensée unique" (the single thought), or what in English is known as "There is No Alternative" (TINA).[2] Optimality is strongly represented by the economic development policies of international institutions like the IMF and the World Bank, the anti-inflation and budget restraint policies of independent central banks, and the market deregulation policies of Western democracies. From the context of this paper, TINA also occurs through the cost-benefit approach to environmental issues. All these optimality-based policies argue that this allows the private decision maker to incorporate costs as a marginal adjustment to the scale and form of any investment or spending decision with the objective of achieving a stable optimal (equilibrium) outcome.

[1] See for example Garnaut (2008, p. 5) where he states: "To achieve effective mitigation at the lowest possible cost, the ETS [Emission Trading Scheme] will need to be supported by measures to correct market failures or weaknesses related to innovation…".

[2] The late John Kenneth Galbraith for more than four decades, beginning with Galbraith (1958), railed against TINA because it encompassed what he called the "conventional wisdom" from where at that vantage point any alternative was difficult to contemplate.

The aim of this paper is to outline a challenge to TINA with respect to sustainable agricultural and regional development. There is an alternative framework that allows a more effective transition to a low-emission economy; one that relies on cooperation rather than competition and conflict to deliver ecologically sustainable innovation (or eco-innovation[3]). Lavoie (2006) identifies post-Keynesian heterodoxy as the alternative economics paradigm that adopts the cooperative model of economic development. However, Lavoie does not tackle the way that this paradigm can be used to develop a climate change framework towards a low-emission economy. The task here is to develop such an eco-innovation policy framework for regional economies. From Stilwell (1974, p. 195), a region is delineated as a community of interests with social cohesion and ecological unity. Social cohesion tends to support the TINA syndrome, while on the other hand; ecological unity identifies strong environmental concerns that characterise a region. Apprehension exists in regions as they try to resolve this tension.

The next section of this paper briefly summarises the arguments why the optimality approach will remain powerless to meet directly the climate change challenge in regional economies. The following section adopts the alternative satisficing approach to develop an 'eco-sustainable framework' for innovation policy in regional economies. This 'eco-sustainable framework' is an attempt to set a policy framework for economic development based on consistent and workable public policy tools that encourage and support entrepreneurial innovation that is greenhouse ecologically congruent, and enacted by "ecopreneurs" (Schaper, 2005). The paper then outlines practical applications in regional communities of this framework using concrete examples of ecological-based strategies and their integration into a complete innovation policy that directly addresses climate change.

Before going any further, sustainable development as a concept needs to be defined. Sustainable development became popular in 1987 after the contemporaneous publication of the 'Bruntland Report' (WCED, 1987) and the environment pamphlet from the World Bank (1987).[4] In a general popular sense, sustainable development refers to economic development which "…meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987, p. 8) Many actions can be implemented in aiming towards this sustainable development concept by people, organisations (especially businesses) and governments; including energy efficiency, recycling, reduced planned obsolescence, improved mass public transport. However, the underlying element that ensures sustainable development is the embodied technology in capital plant and equipment that enables the above actions to effectively prosper. This is the investment decision to support innovation that is the focus of this paper, and it employs the policy definition of sustainable development by Vercelli (1998, p. 268) where economic development is "…considered sustainable only when future generations are guaranteed a set of options at least as wide as that possessed by the current generation."

[3] Van Berkel (2007a) defines "eco-innovation" as "…environment-informed and -driven improvements and innovations in products, services and processes that deliver more value to producers and/or consumers while progressively reducing net environmental impacts."
[4] For a short account of the genealogy of the term, see Vercelli (1998, pp. 267-8).

Optimality Framework

The optimality policy approach, based on mainstream neoclassical economics, drives the market-based competitive-oriented framework. In this framework, governments only set broad parameters within which the private sector operates. At the macroeconomic level it involves the setting of medium term targets on fiscal (for example, balanced budgets) and monetary (for example, minimum inflation) public policies, so that market forces can respond flexibly towards some stable market signals. With this comes a deregulatory agenda to foster private investment strategy that restructures away from protected mature industries to higher value added growth industries. The aim is to provide the investment decision makers with more efficient flow of market information and removing interventionist public policies that distort this market information with increased uncertainty and instability.

For environmental protection, the mainstream optimality approach recognises the efficiency gains from market-based instruments (for example, tradeable resource and emission permits) over direct legal regulation (Godal and Klaassen, 2006). This allows the private decision maker to incorporate environmental costs as a marginal adjustment to the scale and form of the investment project, rather than just as a fixed regulated cost. From this overview of mainstream environmental economics, the overwhelming impression is one of microeconomic optimality. Research concentrates on valuation, types of instruments and resource constraints within particular regulatory regimes; allowing market signals to provide the appropriate environmental response (Eckersley, 1995, p. 15). Sustainable development is merely assumed in the macro perspective as a future state that the economy reaches.

Ecological economics is the alternative to mainstream environmental economics, which has been dubbed "constrained market environmentalism" by Eckersley (1995). However, the investment process operates the same way as with mainstream economics but with an optimal scale of production where there is a balance of material-energy throughputs into the economy that maintains the flows from the ecosystem at a constant sustainable level. This is called steady-state, and is a pre-analytical optimal setting. Size of the investment projects is predetermined, yet there exists market-based encouragement to develop ecologically sustainable technology. Pearce and Atkinson (1993) begin discussion of steady-state with: "To do this we adopt a neoclassical stance and *assume* the possibility of substitution between 'natural' and 'man-made' capital" (p. 104, original emphasis). This analytical devise by ecological economists assumes overriding steady-state optimality.

Vercelli (1998) argues cogently from first principles that uncertainty in the market makes any optimisation algorithm based on substantive (or unbounded) rationality impossible to be expressed in anyway that would have operational significance.[5] The elements of irreversibility and complexity that arise over real historical time imply that an adaptive procedural (or bounded) rationality is required. This means that the objective of sustainable development can only be achieved in a cumulative process of "learning by doing" and acquiring knowledge through implementation of acceptable

[5] In fact Costanza and Daly (1992, p. 45) acknowledge that "[u]ncertainty itself is one of the critical factors that must be addressed in designing sustainable policies", suggesting that a natural capital depletion tax with some form of refundable assurance scheme to handle uncertainty. Problem is that this type of scheme will be subject to the same speculative pressures (and bubble booms) arising from capitalist uncertainty that occurs with any market-based approach.

adaptive (non-optimal) conventions and rules. Thus neither optimal approach to the environment will deliver sustainable development under conditions of market uncertainty. The result instead is the type of market failures described earlier by Garnaut which fail to provide adequate or even correct signals to induce eco-innovation.[6]

From the regional perspective on the environment, mainstream market failures are (or attempted to be) resolved by broad national and state government interventions. However, such interventions come up against individual regional interests that militate against the required social cohesion and ecological unity which make interventions successful. In Australia the unresolved Murray-Darling Basin river salination is an example of how the concerns of specific regional interests along the whole Murray-Darling river system have not been addressed.[7] Market failures are addressed by establishing (often after community consultation) centralised 'top-down' adjustments to incentives, regulatory responses and improved information provision. All such actions can be useful, but regional interests (that can often be divergent) can not be integrated towards a long term community strategy.[8] The alternative steady-state approach resolves the same issues by beginning with an optimal level and then uses that level to determine pricing and incentives. Uncertainties attached to resource availability and use, as identified by Adamson et al. (2005), make any such pre-analytic optimality constraints highly contingent on what authorities have been able to centrally determine. Regional interests again are marginal to the policy action.

The existing economic optimality paradigm is clearly inappropriate for responding effectively and timely to crucial ecological concern like greenhouse warming. A completely different economic framework, based on economic activity that is *satisficing* (under conditions of ecological uncertainty) rather than *optimising* (under conditions of calculable risk) is required to address climate change.

Eco-sustainable Framework[9]

The following is presented as a specific detailed policy framework in the area of investment and innovation to a sustainable development future divorced of the optimality chimera. This is a two-step framework. First step is the provision of a bounded rationality (or satisficing) approach to the ecosystem and its links to the economy, which enables the creation of a cumulative iterative process towards sustainable development. Second step is to specify a policy approach that is based on a 'bottom-up' development of customs and norms around sustainable development,

[6] For a more detailed critique of the optimality approach in relation to the environment, see Courvisanos (2008).

[7] Goss (2003, p. 619) reports on the Murray-Darling River Basin that: "There is no agreed process for incorporating terrestrial biodiversity values at risk into a strategic response for dryland-salinity management. This is a public policy issue to be addressed." There is evidence that after 100 years, this public policy issue is finally being addressed with the COAG (Council of Australian Governments) Meeting of the 26 March 2008 agreeing to a new centralised water body and significant new Federal funding. However, as *The Australian* editorial on the following day states: "There is plenty of work yet to be done to decide what priority water projects will qualify for commonwealth funding and how best to deal with the thorny issue of buying back water rights that have been over-allocated by state governments." (27 March 2008, p. 17)

[8] This problem can be evidenced by a quote from a mainstream neoclassical economics study that argues "…that there is *at least theoretical* support for the notion of an *optimal* level of effort to devote to any community consultation activity." (Crase et al., 2005, p. 235, emphasis added)

[9] This section is a revised and shortened version of Section 3 of Courvisanos (2005).

together with the requisite need for a cumulative growth in effective demand beginning with niche markets that have strong potential for demand expansion.

The policy framework aims to operate in a world of fundamental uncertainty (see Davidson, 1991) and cumulative change (see Kaldor, 1966) within the context of an innovative and sustainable environment. In terms of policy action, the framework has *satisficing* rather than *optimising* objectives at its base, as first espoused by Simon (1976) and since then adopted in behavioural analyses (Earl, 1989). Vercelli (1998) has cogently argued that the satisficing objective is required for efficiency and ethical reasons due to fundamental (or "hard") uncertainty, irreversible processes, and strategic learning. He concludes with the need for a "designing rationality" that is "…aimed at designing a project of harmonious interaction between economic development and the natural environment and able to specify a strategy for its implementation." (p. 273) The satisficing framework outlined below is based on this designing rationality, being broadly rational in rigorous economic terms and also ecologically sustainable in handling ecosystem dilemmas.

As a policy framework, the political economy of the environment and investment needs to deliver an innovation strategy that has a broad and developing long-run sustainable development scenario. The satisficing approach needs to be cumulative and iterative in the short-run, developing strong market share and effective demand for eco-innovations.[10] As more information and knowledge develops, the policy can be recalibrated towards a more sustainable long-run outcome. The framework sets up guiding principles for transition to sustainable development. Transition to a new path of economic development is known as a traverse which results in regime change by the adoption of (i) leading edge knowledge, (ii) new practices and (iii) different social organisations.[11]

The procedural framework begins with identifiable goals and then develops a strategy of public intervention in order to meet Vercelli's definition of sustainable development specified at the start of this paper.[12] Vercelli (1998, p. 274) in his conclusion explains why long-run goals need to be established:

> One of the main reasons for the deterioration of environmental problems may be ascribed precisely to the myopia of economic agents increasingly obsessed by very short-run objectives. Short-run rationality produces a profound irrationality in the longer run. Only a broader long-run rationality may produce a process of sustainable development avoiding deep regrets.

The framework is based on the policy planning research of two traverse-based economists. Together, the principles outlined from these two economists provide a

[10] The hybrid (petrol-electric) car is a recent example of how effective demand ensures growing market share for an innovation. The problem is that this demand has come very belatedly out of large petrol price rises (market signals). The technology has been around for a long time, but there has not been any sustainable development planning process to introduce it earlier into the capitalist economies. Current neoliberal economic policies in advanced capitalist economies have prevented such satisficing planning procedures advocated in this paper.

[11] Examples of past transitions are: sailing to steam ships (1850-1914), gas to electric power (1878-1900), high to low death rates (1850-1900), residential coal to natural gas (1960-75), typewriters to computers (1970-90). The first three in the list co-evolved, see Geels (2005) for more details.

[12] Goals, and targets, are crucial in any sustainable development planning project. Appreciation of the current systems that need to be transformed to achieve the appropriate sustainable development goals is a basic approach in all ecological economics towards sustainability (see Hirsch Hadorn et al., 2006).

paradigm shift in policies towards sustainable development. First is Adolph Lowe's supply side "instrumental analysis" as a way of using "instruments" to achieve agreed goals. Lowe (1976) establishes an analytical framework designed to enable rules of formal logic to be applied to economic cause and effect sequences over historical time. This framework is particularly aimed at using such cause-effect principles to set up state structural adjustment policies that can deliver a sustainable, equitable and ecologically supportive economic environment. This requires a paradigm shift away from existing technological solutions. Lowe calls this "…the search for the economic means suitable for the attainment of any stipulated end. To this procedure I have assigned the label of instrumental analysis." (Lowe, 1976, pp. 11-12)[13] Forstater (1999) refers to this as "retroduction", a search procedure that works backwards from ends (in this case sustainable development) to means (in this case planning by - what Lowe labels – "regressive inferences").

Lowe argues that public policy instrumental analysis needs to concentrate on investment, which is the central element of any path to economic growth. Thus, any path to sustainable development must primarily concentrate on the type of capital stock that will carry, via effective demand, the economy forward into the long-run. Analysis and evidence show that uncertainty by the "mistake-ridden private sector" causes investment instability and undermines any smooth effective path to economic growth (Courvisanos, 1996, pp. 190-2).[14] Further, Lowe explains that in market-based economic regions that lack relevant supportive physical and social infrastructure, there is insufficient order and coherence to impel the creation and market demand of innovative ecologically sustainable investment projects by the private sector. A state structural adjustment policy with appropriate infrastructure spending is needed to underpin the path to sustainable development.

Second is Michał Kalecki's demand side "perspective planning" (Kalecki, 1986). This is incorporated into the framework to provide an investment strategy that establishes motivation and voluntary conformity towards ecologically appropriate goals. A path of dynamic diffusion of new technology systems needs to be set up that is conducive to innovation in investment for a sustainable physical environment. This requires an extensive long-run investment strategy with an incrementally adjusting perspective planning approach. To achieve this it is necessary to specify practical short-run targets that induce, through effective demand, innovation in investment which eventually adds up to the long-run goals specified. Targets need to be monitored and plans must be assessed at regular short-run 'end points' to see whether it is necessary to revise the goals and the strategy for reaching the broad based long-run scenario. A perspective plan with these goals is set up to form a specific investment program in consort with agreed ecological 'rules' that deliver the type of ecological sustainability determined by the instrumental analysis.

In Kalecki (1963)'s study of planning dynamics, there are two specific resource saving parameters that provide ecological-efficient criteria for rules formulation. One is the coefficient of real depreciation, the aim of which is to reduce this coefficient by

[13] See the excellent exposition of Lowe's work in Oakley (1987).

[14] See also Richardson (1960) for details on lack of coordination in markets for investment and the systemic failures that this creates. Richardson goes on to specify how investment coordination through information agreements and industrial concentration can assist in developing micro-goals in policy oriented strategies.

proper maintenance and repair systems to equipment and infrastructures. The other is the coefficient of better utilisation of existing productive capacity. "Greater output may be obtained from existing plant due to improvements in the organization of labour, more economical use of raw materials, elimination of faulty products, etc." (Kalecki, 1963, p. 16), thus reducing the coefficient's value. Together these resource saving coefficients provide a sound basis for ecological rules within a sustainable investment strategy.

Barbier (1989) developed some ecologically sustainable rules that could form the basis of any Lowe-Kalecki planning approach. These rules deal with rates of both exploitation of natural resources and generation of wastes that specific ecosystems can assimilate for long-run 'carrying capacity' sustainability. The problem is that different 'stakeholders' (or interest groups) in the economy use alternative critical load carrying capacity measures in relation to the ecosystem. Within the context of tourism, Hoffmann (1998) identifies three carrying capacity measures that can be applied to the ecosystem in general:

(i) *physical* capacity as the absolute limit that a resource can cope with;
(ii) ecological or *real* carrying capacity as the level beyond which there are unacceptable ecological impacts for ecologists;
(iii) social or *effective* carrying capacity as the level beyond which unacceptable change occurs in the production of the good or service in terms of overcrowding and altering social behaviour.

Large business interests tend to support (i). Small and local based businesses, public environmental bureaucracies and ecologists tend to support (ii). The direct service providers 'on the ground' (for example: national park rangers, local environment groups, low impact ecosystem based services) tend to support (iii). Kalecki's resource saving coefficients can be applied to all three capacity measures.

The perspective planning approach needs to first set up a dialogue between all stakeholders on how to achieve a deeper ecosystem sensitive market in any region or country using structural adjustment policies that plan to alter the economic base of that area. The aim is investment, not in 'end of pipe' solutions to the ecosystem, but in an innovative proactive strategy that significantly alters the operation of the economy using all the tools available in the new information and communication technologies (ICT). This requires understanding of the possible means to develop the economy with ICT investment and an appreciation of the value of all three carrying capacity indicators as rules for monitoring, evaluating and developing each stage in the plan. Networking between all the stakeholders over the goals, means and their assessment must be rapid and continuous. Then processes need to be arranged where constructive dialogue concentrates on the means of achieving the goals based on the data available and rules used to assess this data. Once an investment plan has been developed, there must be continual re-evaluation of these rules over time so that they are not static, but instead reflect the latest innovative technological changes. This ensures the constrained investment strategy is flexible and adaptable.

When setting up rules within either the planning process (e.g. low-emission public transport system), or regulating the market (e.g. emission trading scheme), Hodge (1995, p. 56) explains that to have confidence in the effectiveness of these rules "…any prescriptions will have to embrace a wide range of capital assets and precautionary rather than optimising approaches have to be adopted." This supports

the satisficing rather than the optimising approach to sustainable development. An eco-sustainable framework can provide a level of confidence that the rules can be adhered. Such confidence induces innovation in investment, leading to revisions both in carrying capacities and economic growth for future iterative re-evaluations of the perspective plan. This cumulative and feedback process has the ability to establish precautionary rules to effectively meet the goal of sustaining the ecosystem, while regularly evaluating and revising the rules for getting there.

Since it is impossible to define with any certainty what sustainability requires, a risk-averse investment strategy needs to be initially introduced, and not based on a static optimising (and optimistic) scale of production. This clearly points to the use of the *effective* carrying capacity rate as the critical ruling measure. Over time what sustainability requires is a "shifting target" that depends on new information and technology becoming available and on changing attitudes and expectations adopted by the generation that has democratic public control (Hodge, 1995, p. 56). This democratic control implies grassroots input from the people who understand and operate within the fragile ecosystem together with ability to influence directly the goals and means used to develop the ecologically sensitive economy. This approach rejects the bland superficial notion of democracy as some occasional voting for representative leaders, and embraces a more participatory process that requires significant appreciation of the life support systems that need to be taken into account (see Hirsch Hadorn et al., 2006).

In achieving the sustainability objective, Hoffmann (1998) argues for strategic alliances and innovation networks between stakeholders. There are vast ideological and business differences between all stakeholders, especially with regards to their support for different carrying capacity rules. Under these conditions, it seems networks across all stakeholders could be very tenuous. Democratic control requires networking across all parties with specific details of the stipulated sustainable ends, but then decisions on the plans and implementation must be arrived at by majority support. The minority in the network, even if more economically powerful, *must* accept the need to act within the bounds of the majority based plan and policies.

This eco-sustainable framework provides cumulative effective demand growth based on sustainability rules that aim to establish certainty within which innovative investment by the private sector can flourish. Demand growth is managed and nurtured by strong strategic niche markets in eco-innovations. Continual iterative re-evaluation of investment plans encourage further innovation that lead to more acceptable and internationally competitive sustainability rules. This creates self-reinforcing internal dynamics that induce strong international competitiveness, growth and employment.

In summary, this framework has three crucial elements:

1. Cumulative effective demand that establishes a strong market.
2. Ecological rules that ensure capital investment is resource saving with long-run carrying capacities which are sustainable.
3. Perspective, flexible and risk-averse investment strategy with democratic control.

Application to Regional Economies

Although the complete eco-sustainable framework is not in evidence anywhere, elements of it can be seen in various regions/nations in developed economies. There are many practical regional-based implementation strategies for the type of framework proposed here. Diverse practical strategies can be incorporated into a coherent and iterative eco-sustainable innovative approach to environmental policy. From the experience of working for the US Environmental Protection Agency, Norton (2005) diagnoses the shortcomings of US environmental policy. Essentially, Norton's argument is that it lacks both a problem-solving approach and a willingness to evaluate and improve (or discard) on policy experiences. Norton advocates a social science research approach to complement the dominance of neoclassical economics, this being an iterative process of experiential learning from appropriate practice and then adapting towards a better outcome. Norton's pragmatic approach embodies procedural rationality, but is deficient of a long-run satisficing objective of a stipulated sustainable goal that all environmental policies need to embrace.

The European experience in transition to sustainable development by eco-innovations is much deeper than anywhere else on the globe and it confirms the need for a pragmatic iterative, but also sanguine, ecological goal as specified in the eco-sustainable framework outlined above. Australia can learn much from the European applications. René Kemp is the leading advocate in Europe for transition, and he has published much on the practical implementation of various eco-innovation systems, notably in transportation (Kemp and Rotmans, 2004), energy (Kemp and Loorbach, 2005), and waste management (Kemp and Andersen, 2004). The essence of the Kemp advocacy is that transition can not be controlled, but can be influenced, directly and indirectly through the use of markets, hierarchy and institutions. Market influence is when permissible limits are set and the market sets permit price (e.g. regulated emission trading scheme[15]). Hierarchical influence is when economic activities are centrally coordinated (e.g. urban transport planning[16]). Institutional influence is through setting standards, establishing trust, creating networks and sharing beliefs (Parto, 2005). Together the three influences form the essential transition management tools. Regime change comes from 'top-down' planning and regulation by government policy. 'Bottom-up' initiatives by business and other interest groups establish niche solutions that need to grow with the support of public policies. The specific mix of 'top' and 'bottom' depends on the particular region and the embeddedness of current practices. This is where regional analysis comes into its own.

As Norton (2005) notes, it is this iterative feedback approach that can revitalise local communities. In Australia, the regional (non-metropolitan) communities are physically closer to the ecosystem and have definite (sometimes very contrasting) values that allow potentially effective voices to be heard in the process. However, the regional initiatives should dovetail in a co-ordinated manner into an overall national sustainable development agenda. This agenda would aim to reflect agreed global environmental protocols and regulations. Like Russian dolls, each smaller regional focus must neatly fit into the larger regional focus. Given the uncertainty in the future, the 'fitness' is more on common approach with different iterative paths of transition to ecological targets in specified long-term international protocols. These protocols

[15] See Ellerman and Buchner (2007).
[16] See City Of London (2007)

need to gradually incorporate developing economies as their levels of economic activity begin to have significant global environmental implications.

Figure 1 summarises the argument of this paper in the *grid* and provides a *flowchart* of the investment planning process on the bottom. The left column has the three pillars of the eco-sustainable framework. The centre column sets out the criteria for sustainable development required in both public and private sector investment planning within specific institutional and cultural domains. The right column shows how specific Australian regional-based practical greenhouse strategies for innovation have the potential to support the proposed investment plan. The bottom row is a flowchart which indicates how one column should interact. The flowchart is a practical procedure for a coherent planning process. This framework offers a cohesive framework for investment that allows specific strategies to induce eco-innovation. This then takes the strategies out of the environmental divisions of the public/private sectors and locates them in the central decision-making processes. Then, the environment is no longer a separate strategy, but instead a stipulated end that is integrated in the strategic management and planning of any (and every) organisation.

Focus now moves to identifying regional applications that appear in the right-hand column of Figure 1. These are all examples that have been appraised by other authors, and they are placed within the context of the eco-sustainable framework. Currently all such examples (and there are many more throughout the country that are not mentioned here) make up a plethora eco-sustainable 'patches' that are not connected together into some coherent patchwork. All the examples mentioned have developed strong regional niche markets, but for an effective transition to sustainability there is a need to have all three elements linked together with the investment criteria in the second column. This linking must first be at one region, and then extended to other regions with ties across regions. An example of linking the patches together to effect a regime change transition in the past was the automobile. What changed a quaint niche activity into the major transportation system of the 20th Century was government planning of roads, traffic lights and related infrastructure, together with the business development of petrol stations, auto-mechanics, tow truck operations, road service and the like. Integration of such diverse activities occurred as public planning was linked to road carrying capacities, with flexible road developments that were evaluated in the context of user demand for the new innovation.[17] The greenhouse gas imperative requires the petrol-driven automobile to be placed in the 'dustbin' of history, but technological lock-in is a powerful force against which regime change must defeat.

Regional implementation examples identified in Figure 1 begin with ecological rules; one example of a business establishing ecological rules, while another example concentrates on communicating such rules. Pig Pen is a sustainable intensive pig farming operation in North East Victoria using the triple bottom line with a strong adaptive capacity over seven years and a tiny ecological footprint (Penniceard, 2007).[18] This operation provides a paradigm shift in agriculture, establishing new

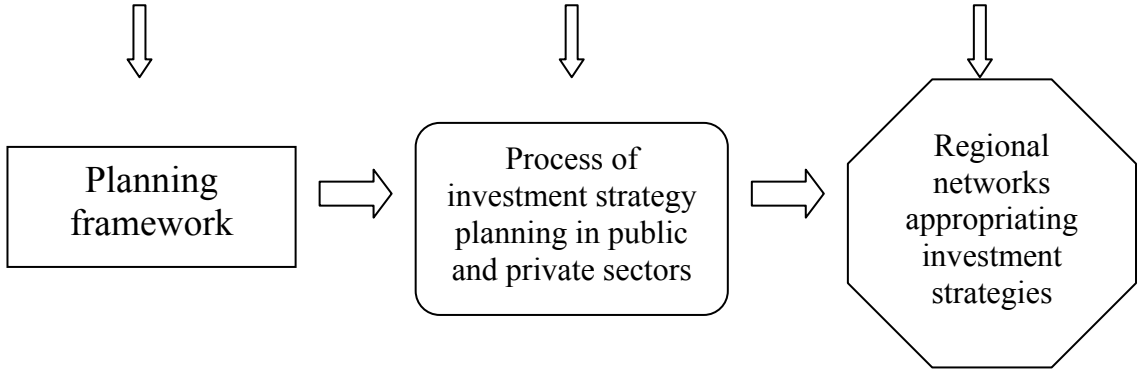
[17] For a history of the automobile and the environment around it, see Wachs and Crawford (1992).

[18] Agriculture has a relatively large ecological footprint in Australia. "Greenhouse gas emissions from agricultural production represented approximately 16% of total national emissions in 2005, a proportion higher than that of any other OECD country apart from New Zealand." (Department of Climate Change, 2008)

ecological agricultural rules. "The Break" Newsletter provides information throughout the broad cropping regions of Victoria and southern New South Wales on climate change and seasonal risk factors. This online newsletter has the basis for communicating ecological rules and reducing uncertainty in a highly climate variable environment (Price et al., 2008).

FIGURE 1: The Eco-sustainable Framework

Eco-sustainable elements	Investment planning criteria	Regional-based implementation strategies
Ecological rules	• Sustainable long-term carrying capacities • Resource-saving new capital stock	Develop and communicate appropriate sustainability rules (e.g. Pig Pen, "The Break")
Perspective planning	• Iterative flexible *ex-ante* planning • Bottom-up monitoring and evaluation	Establish, monitor, evaluate and adapt environmental policies (e.g. CMAs, VCCAP)
Cumulative effective demand	• Strong niche market base • Experience from current eco-sustainable innovation-based users	Niche management of regional network user-led activities (e.g. Landcare, Coastcare, SmartGreen)



At the regional perspective planning level, two examples of iterative flexible planning, monitoring and evaluation are VCCAP and CMAs. Under the Victorian Climate Change Adaptation Program (VCCAP) an interdisciplinary team from the University of Melbourne and two Victorian state departments undertake research, communication and policy development for agricultural industries in the context of climate change problems (Griffin and Eckard, 2007). Natural Management Regions across Australia lead the cost-effective protection and enhancement of the land and water resources in network of 56 distinct regions under the National Action Plan for Salinity and Water Quality (NAP) and are evaluated in Head (2005). Water Catchment Management Authorities (CMAs) in Victoria implement the NAP and provide the basis for adaptive environmental policies.

Australia has been very successful at developing many strategic niche bases for eco-sustainable management which enable cumulative effective demand to be built for growing awareness in, and demand for, natural environment 'goods'. Probably the most successful one of these is Landcare, a national community-based network that is government and corporate-funded. Established in 1989, Landcare implements landscape improvement (e.g. plant trees) and develops a positive attitude to sustainable land management through education (Huthwaite, 2007). Community-focused, with the state playing little role in assigning priorities or resolving trade-offs, Campbell (1994) recognises the lack of a top-down institutional approach as the strength in this participatory approach. This network approach has been adopted by Coastcare to manage the coast, but with more state input from the Victorian Government. From another angle on strategic niche management, SmartGreen is a new initiative by the University of Ballarat and Ballarat Council to assist a cluster of small businesses in the Ballarat region to be more entrepreneurial and access new business opportunities from sustainable environmental policies and the development and delivery of environmental services. Some idea of the extent of success by such "ecopreneur" (Schaper, 2005) initiatives as SmartGreen can be discerned in Van Berkel (2007b) where he reviews the Cleaner Production and Eco-Efficiency initiatives from 30 Australian small firms that participated in these two eco-innovation government-funded programs.

Implications

The basic argument in this paper is that all economies need to undertake regime change from high-emission to low-emission. This transition to sustainable development requires a paradigm shift in the production and distribution of economic activity, and can only occur *via* eco-innovation. An optimising approach to this transition is rejected in favour of a satisficing approach under conditions of large market uncertainty that occurs in periods of structural change. The analytics of two economists who concentrated their efforts on understanding how economies go through regime change have been employed to develop the policy framework for inducing eco-innovation in a systematic long-run new path of economic development. The Lowe-Kalecki eco-sustainable framework provides a cumulative iterative process that encourages eco-innovation to meet short-run satisficing objectives that dovetail into long-run sustainability. The framework consists of a combination of three critical elements together with a nationwide systemic investment process strategy that funds and supports eco-innovation at all levels of society.

The previous section identified examples of regional eco-innovation and showed how they would fit into the eco-sustainable framework. Thus, aspects of the framework are already deployed around Regional Australia, but they are all small and disparate. What is missing is a coherent framework to all these diverse and *ad hoc* occurrences. Two regional implications emerge from the eco-sustainable framework. One implication is the adaptive governance approach that regional authorities need to adopt towards global environment problems. This requires recognition of local development of customs and norms around sustainable development that create social cohesion and ecological unity. Conflicts will inevitable arise (e.g. local opposition to wind farms), but such conflicts can be overcome at the local level through the adaptive governance approach to the satisficing objective outlined above. National and international protocols and regulations will enable such localised conflicts to be resolved in a coherent manner consistent with sustainable development. The second

implication is based on the "Butterfly Effect" as it is applied to economic systems (Ormerod, 1998).[19] This effect can be applied to small niche eco-innovations by recognising that local consequences will be amplified via flow-on diffusion effects in the evolution of the new sustainable development paradigm, but within the context of the agreed global/national ecologically sustainable rules and the perspective planning governing the new paradigm. As diffusion proceeds, learning takes place that improves the innovation as it adapts to different regional circumstances. Over time the rate of diffusion will rise quickly (Rosenberg, 1972).

Research implications relate to adopting the eco-sustainable framework as a benchmark to monitor and evaluate the various regional programs and initiatives that develop. Rather than simply describing and critiquing a program, this framework enables the researcher to find what are the elements of the program that support the new transition paradigm and what are the missing or negative features of the program that work to detract from the transition. It can also lead to an iterative process of identifying the strengths of a regional program that the current policy is not addressing, then the policy must adapt to allow the regional initiative to create a strong "butterfly effect". From the opposite angle, rates of diffusion of eco-innovations will vary from region to region depending on economic, cultural and technological factors. Given the diversity of alternative sustainable activities (e.g. sources of energy like wind, solar, geothermal, tidal, biomass, nuclear, bio-fuels) such variety needs to be encouraged and supported in the perspective plan, if these activities are within the context of the paradigm transition that has been mapped out. Here the research effort must be to identify the diffusion of eco-innovations (technologies and activities) and focus on whether scarce resources are being used in the most effective methods for commercialisation. This is where researching the strength of regional input can more clearly identify commercial possibilities.[20]

Finally, policy implications of the framework need to be identified. Decentralisation of eco-innovation is the resolute strategic process from this framework; otherwise the regional voice will be lost in centralised policymaking at national and international forums. The tendency to centralisation is obvious both in politics (where power continually moves vertically upwards) and in business (where fixed costs of adoption on new technologies favour larger firms). This amounts to strong barriers to adoption. Strategies need to understand these barriers and provide through the framework ways that political power and business costs are defrayed so that regional actions can be subsidised, learning assisted and allowed to develop as self-reinforcing diffusion mechanisms that have the potential to create critical mass. Rapid diffusion of eco-innovations holds the key to arresting the high-emission climate change scenario referred to at the beginning of this paper.

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[19] The Butterfly Effect was proposed by Edward Lorenz in 1963. He argued that the flapping of a butterfly's wing would cause a disturbance that becomes exponentially amplified so as to eventually affect large-scale atmospheric motion. Ormerod (1998) described the same effect by a biological experiment on ants which showed that when an ant goes out and finds food, this encourages others to follow it back to its source. In this experiment, the self-reinforcing mechanism is very strong. From an evolutionary economics perspective, Ormerod applied this mechanism to economic activities at a local level to show both positive and negative outcomes. As Paul Kelly sings: "From little things, big things grow."

[20] For an example of how to use this eco-sustainable framework to analyse an environmental policy and the role of regional input, see Courvisanos and Jain (2006).

Garnaut (2008) argues that Australia needs three targets to meet the ecological threat. The first would be geared to meeting Australia's 2020 target. The second would be more ambitious aimed to reduce emissions by 60 per cent. The third would be the most ambitious aiming beyond 60 per cent. The eco-sustainable framework makes such a three-pronged target able to be clearly and coherently set out in one policy strategy. The framework would allow for an iterative progression towards these targets. Most importantly, the framework allows for a broad localised input into the setting and implementation of the targets in the light of developments as they occur in the effort at transition to sustainability. This approach can be applied to any economy, using regional communities and their networks as the bulwark for democratically devising the ecological rules for a nationally stipulated precautionary low-emission economy target. Then, regions can strongly input into a national "perspective plan" with regional targets and creating strategic niche regional markets to implement these strategies. Critical mass for sustainable development is the objective and it needs to begin immediately.

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